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The Risk Factors for Nosocomial Sepsis in Neonatal Intensive Care Unit: Prospective Observation Study

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Abstract: ***Background: Nosocomial infection is defined as an infection occuring at any site, which was acquired during hospitalization & results from inoculation of an organism that was not present or incubating in a patient at the time of admission. There are differences in reporting Nosocomial infections, particularly the timing of onset. Because neonatal Nosocomial infections are known causes of morbidity and mortality in all neonates but particularly in the smallest, the most immature infants, it is important to determine whether the infection risk is inherent to the infant or can be affected by environment and the treatment received in NICU. Aim: To determine the risk factors associated with development of nosocomial sepsis, clinical features, microorganisms, laboratory investigation, blood culture & sensitivity evaluation to incidence & mortality of nosocomial sepsis for better outcome of neonates in NICU. Material & Methods: This is Prospective observational study conducted at UPMC & Hospital, study population was all babies admitted in NICU over the period of 2 years showing clinical features of sepsis >48hrs of admission in whom laboratory investigations support the diagnosis. During the study period a total 625 neonates were admitted to NICU. All these neonates were screened for nosocomial sepsis. Out of all admitted neonates 140 met the inclusion criteria. Results: Incidence of nosocomial sepsis was 21.47%. Neonatal factors such as gender, weight, prematurity, asphyxia, resuscitation (bag and mask, ET intubation & 02 by nasal cannulation), number of needle pricks and TPN show statistically significant association with nosocomial sepsis. The maternal risk factors which showed significant statistical association were pregnancy induced hypertension and more than 3 vaginal examinations. Most commonly observed symptoms are lethargy (80%), icterus (69.29 %) and poor weight gain (65.71%). Lesser common manifestation include tachypnea (52.14%), refusal to suck (48.56%), abdominal distension (47.86%) & hypothermia (44.29%) and least common being irritability (12.86), sclerema (7.86%) and fever (6.43%). Mean duration of stay in NICU was 10.48 days. Conclusion: The most common organism isolated was klebsiella pneumonia followed by E. Coli followed by least common were streptococcus species. The mortality rate due to nosocomial sepsis was found to be 27.86%***

Keywords: Nosocomial Sepsis, NICU, Infection, Newborn, Prevention, CLABSI, VAP

1. Introduction

The incidence of NIs in NICU is approximately 30% and is responsible for up to 40% of reported neonatal deaths in developing countries. In developing countries, during neonatal period, it is estimated that approximately 4 million deaths occur annually, mostly due to infection, birth asphyxia and as a consequence of premature birth and low birth weight. The incidence of neonatal sepsis varies from 1-4/1000 live birth in developed countries, to 10-50 /1000 live birth in developing countries Data from the national institute of child health and human development sponsored “neonatal network” indicated that 29% of infant born at 25 to 28 weeks of gestation and 46% of infants born at less than 25 weeks gestation experience a serious nosocomial infection during hospitalization in the NICU. According to CDC nosocomial sepsis is defined as positive blood culture at more than 48 hours of life with clinical signs or symptoms of infection. Khalid et al in their studies stated that N occurs 48 hours after admission in a baby who did not have evidence of an infection on admission, characterized by growth of pathogen not related to infection at another site from one blood culture or positive polymerase chain reaction in the presence of clinical features of infection. Hematologic scoring system for early evaluation of neonatal sepsis also accept nosocomial sepsis developing after 48 hours of admission.2 major categories-

Early onset sepsis: it presents within the first 72 hours of life. The source of infection is generally maternal genital tract.

Late onset sepsis: it usually presents after 72 hours of age. The source of infection is either nosocomial or community acquired and neonates usually present with septicemia, pneumonia or meningitis.

Neonatal infection could be categorized according to 5 sources:

a) Congenital infections with onset in utero.
b) Infections acquired during the birth process from the maternal genital tract.
c) Infections acquired in the nursery.
d) Infections acquired in the household after discharged from the nursery.
e) Infections suggesting an anatomic defect, underlying immunologic diseases or metabolic abnormality.

The single most important risk factor for infection in the neonate is prematurity. Neonatal factors that increase infants'

chance of becoming sick include: low birth weight, prematurity, birth asphyxia, meconium staining, resuscitation. There is a direct correlation between gestational age and the infants risk for infections. Infants born at less than 32 weeks of gestation have a 4 to 25 times higher risk of developing an early onset infection. Reasons for these include immature immune system, thinner skin, and the frequent need for insertion of foreign objects.

Prematurity and very low birth weight infants appear to be particularly vulnerable to nosocomial sepsis due to relative immune deficiency e.g. hypogammaglobulinemia, poor phagocytosis etc. Numerous other factors associated with an increased risk of nosocomial infection include: neutropenia associated with hypertensive mother, degree of maturity, PROM, and maternal diseases or infection. Male gender and decreased baseline serum immunoglobulin G concentration were also associated with an increased risk of blood culture proven sepsis. Neonatal intensive care unit therapies that provide a portal of entry of pathogens include intubation and ventilation, central venous catheters & parenteral nutrition, peripheral intravenous lines, venipuncture or heel stick blood draws & indwelling urinary catheters, of all above, use of central venous catheters is most frequently associated with NI. Other identified NI risk factors as change the flora in the infant and/or the environment and include prolonged, nil per oral (nothing by mouth) and frequent or prophylactic use of antibiotics. The initial manifestation may involve only limited symptomatology and only one system such as apnea alone or tachypnea with retractions or tachycardia or it may be an acute catastrophic manifestation with multiorgan dysfunction. Manifestation included temperature instability, hypotension, poor perfusion with pallor and mottled skin, metabolic acidosis, tachycardia or bradycardia, apnea, respiratory distress, grunting, cyanosis, irritability, lethargy seizures, feeding intolerance, abdominal distension, jaundice, petechiae, purpura and bleeding. Later complication of sepsis include respiratory failure, pulmonary hypertension, cardiac failure, shock, renal failure, liver dysfunction, cerebral edema, or thrombosis, adrenal hemorrhage and or insufficiency, bone marrow dysfunction (neutropenia, thrombocytopenia, anemia) and disseminated intravascular coagulopathy (DIC). Infant should be re-evaluated over time to determine whether the symptoms have progressed from mild to severe. Associated focal infections can be Meningitis Pneumonia, Urinary tract infection, Omphalitis, Conjunctivitis, Abscess of skin, Impetigo, Otitis media, Septic arthritis, Osteomyelitis, Infected cephalhematoma.

Aim

To determine the risk factors associated with development of nosocomial sepsis, clinical features, microorganisms, laboratory investigation, blood culture & sensitivity evaluation to incidence & mortality of nosocomial sepsis for better outcome of neonates in NICU.

2. Material & Methods

This is Prospective observational study conducted at UPMC & Hospital, study population was all babies admitted in NICU over the period of 2 years showing clinical features of sepsis >48hrs of admission in whom laboratory investigations support the diagnosis. During the study period a total 625 neonates were admitted to NICU. All these neonates were screened for nosocomial sepsis. Out of all admitted neonates 140 met the inclusion criteria.

Study sample was subjected to laboratory investigations in babies with suspected sepsis which include hemoglobin, total leukocyte count, differential leukocyte count and band cell count, ESR, C-reactive protein, urine examination, X ray chest and CSF study when required were done. First blood culture was sent in all babies admitted; if positive the baby was excluded from the study. Second blood culture was sent after 48hours, if sepsis was suspected.

Statistical analysis and methodThe data was obtained and arranged according to characters during hospitalization, risk factor forsepsis, symptom of sepsis, duration of development of sepsis, duration of stay, blood culture, organism and outcome. Data will be collected by using a structure proforma. Data entered in MS excel sheet andanalysed by using SPSS IBM USA. Qualitative data will be expressed in terms of proportions. Quantitative data will be expressed in terms of Mean and Standard deviation. Descriptive statistics of each variable will be presented in terms of Mean, standard deviation, standard error of mean. Association between two qualitative variables will be found out Association between two qualitative variables will be found out by using chi square/ Fisher's exact test. Association between two quantitative variables will be found out by using unpaired t test. A p value of <0.05 will be considered as statistically significant whereas a p value <0.001 will beconsidered as highly significant

3. Result

All neonates admitted in NICU during the study period were screened for nosocomial sepsis. Out of the 652 neonates admitted during the study period, 140 met the inclusion criteria and with the consent of their respective parents were included in the study. 39 neonates died and 8 lost during follow up. In the present study, incidence of nosocomial sepsis was 21.47% (140/652) and mortality rate of 27.86% (39/14)

Table 1: Incidence of Sex Distribution in Nosocomial Sepsis in Present Study

Sex	Frequency	Percentage (%)
F	62	44.29
M	78	55.71
Total	140	100

Table 13: Weight Distribution Innosocomial Sepsis

S. No.	Weight Classification	Frequency	Percentage (%)
1.	ELBW	7	5
2.	VLBW	56	40
3.	LBW	53	37.86
4.	NORMAL	24	17.14
5.	Total	140	100

Table 14: Prematurity with Nosocomial Sepsis

Prematurity	Frequency	Percentage (%)
Preterm	102	72.86
Term	38	27.14
Total	140	100

Table 15: Gestational Age with nosocomial Sepsis

Gestational Age (Weeks)	Frequency	Percentage (%)
28-30	14	10
30-32	10	7.14
32-34	45	32.14
34-36	31	22.14
36-38	17	12.14
38-40	16	11.43
40-42	4	2.86
>42	3	2.15
Total	140	100

Table 16: Resuscitation Required

Resuscitation Required	Frequency	Percentage (%)
Yes	56	40
No	84	60
Total	140	100

Table 17: Types of Resuscitation

Resuscitation	Frequency	Percentage (%)
BAG ANDMASK		
Yes	16	11.43
No	124	88.57
Total	140	100
Endotracheal Intubation		
Yes	22	15.71
No	118	84.29
Total	140	100
Chest Compression		
Yes	9	6.43
No	131	93.57
Total	140	100
Drugs		
Yes	9	6.43
No	131	93.57
Total	140	100

Table 18: Total Parenteral Nutrition with Nosocomial Sepsis.

Total Parenteral Nutrition	Frequency	Percentage (%)
Yes	60	42.86
No	80	57.14
Total	140	100

Table 19: Needle Pricks and Risk of Nosocomial Sepsis

Number of Needle Pricks	Frequency	Percentage (%)
<10	21	15
>10	119	85
TOTAL	140	100

Table 21: Mode of Delivery with nosocomial sepsis

Mode of Delivery	Frequency	Percentage (%)
Caesarean Section	56	40
Vaginal	84	60
Total	140	100

Table 22: Vaginal Examination with Nosocomial Sepsis

Number of Vaginal Examination	Frequency	Percentage (%)
<3	88	62.86
>3	52	37.14
Total	140	100

Table 23: Symptoms Associated with nosocomialsepsis.

Symptoms	Frequency	Percentage (%)
LETHARGY	112	80
REFUSALTOSUCK	68	48.57
POORCRY	36	25.71
CYANOSIS	18	12.86
TACHYPNOEA	73	52.14
RETRACTION	50	35.71
GRUNTING	53	37.86
ABDOMINALDISTENSION	67	47.86
APNOEA	53	37.86
FEVER	9	6.43
ICTERUS	97	69.29
HYPOTHERMIA	62	44.29
SEIZURE	26	18.57
SCLEREMA	11	7.86
POORWEIGHTGAIN	92	65.71
IRRITABILITY	18	12.86
SHOCK	59	42.14
BLEEDING	21	15
HYPOGLYCEMIA	19	13.57

Table 24: Meningitisin Nosocomial Sepsis

MENINGITIS	Frequency	Percentage (%)
Yes	19	13.57
No	121	86.43
Total	140	100

Table 25: Laboratory Investigations Associated with Nosocomial Sepsis

S. No.	Investigation	Frequency	Percentage (%)
1	SEPSISSCREEN		
	Positive	117	83.57
	Negative	23	16.43
2	TLC		
	<=5000	33	23.57
	5001-34000	95	67.86
	>34000	12	8.57
3	ANC		
	<1800	60	42.86
	>=1800	80	57.14
4	I/TRATIO		
	<0.2	107	76.43
	>0.2	33	23.57
5	PLATELETS		
	<=100000	51	36.43
	>100000	89	63.57
6	MICROESR		
	<=15	42	30
	>!5	98	70
7	CRP		
	<=10	29	20.71
	>10	111	79.29

Table 26: Cultures Associated With Nosocomial Sepsis

S. No.	Culture	Frequency	Percentage (%)
1.	Bloodculture		
	Positive	26	22.81
	Negative	114	81.43
2.	CSF		
	Positive	4	13.79
	Negative	25	86.21
3.	IVC		
	Positive	4	6.78
	Negative	55	93.22
4.	Endotracheal tube tip		
	Positive	6	27.27
	Negative	16	72.73

Table 27: Nosocomial Sepsis and Outcome

Outcome	Frequency	Percentage (%)
AMA	5	3.57
CURED	96	68.57
EXPIRED	39	27.86
Total	140	100

4. Conclusion

During the study period a total of 652 neonates were admitted to the NICU. All these neonates were screened for nosocomial sepsis. Out of all the admitted neonates 140 met the inclusion criteria. Consent was obtained from either parent of respective neonates before inclusion in study. Out of these 39 neonates died and 8 were lost during follow-up. From the study conducted following inferences can be made:

a) In the present study incidence of nosocomial sepsis was 21.47%.
b) Neonatal factors such as gender, weight, prematurity, asphyxia, resuscitation (bagand mask, ET intubation and O2 by nasal cannulation), number of needle pricks and TPN show statistically significant association with nosocomial sepsis.
c) The maternal risk factors which showed significant statistical association were pregnancy induced hypertension and more than 3 vaginal examinations.
d) Out of the different symptomatic manifestations of nosocomial sepsis the most commonly observed symptoms are lethargy (80%), icterus (69.29%) and poor weight gain (65.71%).
e) The lesser common manifestations include tachypnoea (52.14%), refusal to suck (48.57%), abdominal distension (47.86%) and hypothermia (44.29%) and least common being irritability (12.86%), sclerema (7.86%) and fever (6.43%).
f) Mean duration of stay in NICU was10.48days.
g) Septic screenwas positive in 117cases (83.57%), CRP in 111 cases (79.29%), blood culture in 26 cases (22.81%), CSF culture in 4 cases (13.79%), IVC culture in 4 cases (13.79%) and endotracheal tip culture in 6 cases (27.27%).
h) The most common organisms isolated was klebsilella pnemoniae (28.7%), second most common was E. Coli followed by least common were streptococcus species (5.3%).
i) The mortality rate due to nosocomial sepsis was found to be 27.86%.

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Conflicts of interest
There are no conflicts of interest

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